May 19, 1931. D. FERRELL ET AL 1,805,541

BLASTING CARTRIDGE

Filed Feb. 19, 1927

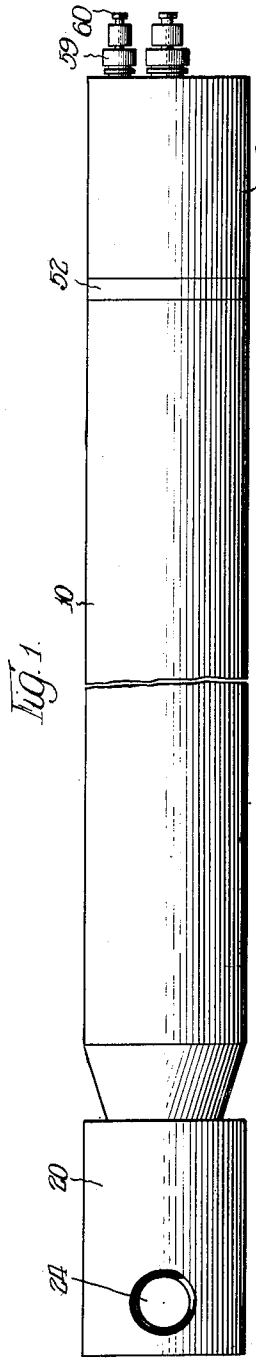


Fig. 1.

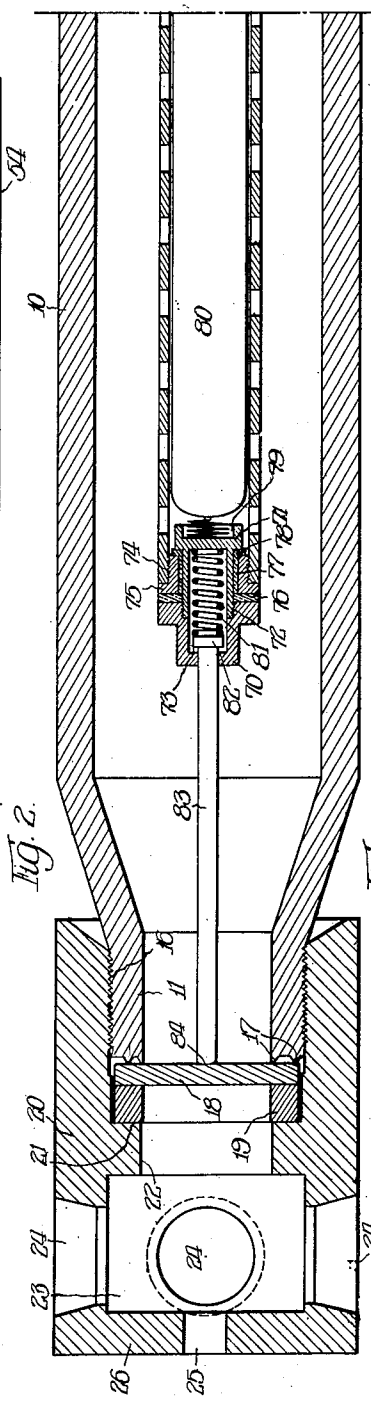


Fig. 2.

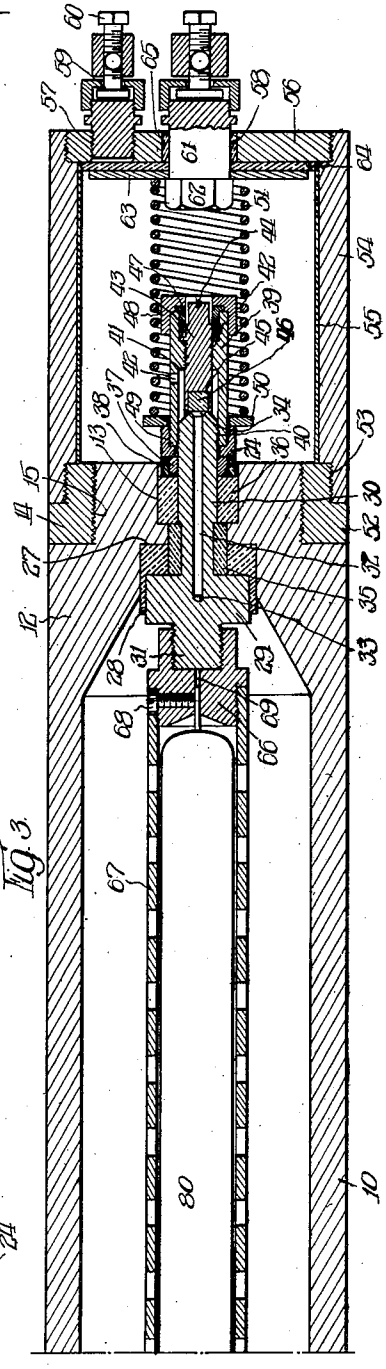


Fig. 3.

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UNITED STATES PATENT OFFICE

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BLASTING CARTRIDGE

Application filed February 19, 1927. Serial No. 169,441.

This invention relates to blasting cartridges, and more particularly to the type of blasting cartridge charged with a substance, under pressure in liquid form, which is gaseous at ordinary temperatures and pressures, and is provided with means for heating the substance very rapidly to and above the critical temperature of said substance to effect a discharge of said cartridge.

This invention is an improvement on the invention disclosed in the patent to Crawford, et al., No. 1,632,887, of June 21, 1927, for blasting cartridges.

One of the objects of this invention is to provide a blasting cartridge which is filled with a substance gaseous at ordinary temperatures and pressures, introduced into the cartridge under pressure until it liquefies, and is further provided with a heating cartridge for rapidly raising the temperature of the liquefied substance to and above its critical temperature.

Another object of this invention is to provide a cartridge of the above described type which is provided with a rupturable end wall adapted to be ruptured to release the contents at a predetermined pressure but which will yield slightly to effect a slow escapement of gas provided excess pressures less than the predetermined pressure are effected, which pressures are caused by a slow vaporizing of the liquid contents.

Another object of this invention is to provide an improved mechanical structure for a cartridge of the above described type which is efficient in operation, simple in structure and is cheap and practical to manufacture.

Another object of this invention is to provide a cartridge comprising a rigid casing having a rupturable wall at one end, said wall being seated and maintained in close contact with a plurality of eccentric knife-edge ring projections whereby a gas-tight seal is effected and means is provided for preventing rotation of the wall relative to its seat.

Another object of this invention is to provide a cartridge having a rupturable wall at one end and having a cap member secured to the outside end provided with a wall portion opposite the discharge end of the cartridge and having transverse openings to accommodate the outward passage of the gas. The object of this structure is to provide a cartridge which will be free of any tendency under discharge to move longitudinally in the drill hole.

Another object is to provide a cap means of the type described in the next above stated object which will serve as a cage for catching and retaining the ruptured end wall when it is discharged outwardly.

Another object of this invention is to provide a cartridge of the type described in the above stated objects in which a heating cartridge is provided positioned internally of the rigid casing and being adapted to be replaced with fresh cartridges when the rigid casing is refilled, the heating cartridge being electrically discharged and having a yielding electric connection to effect the contact from one end thereof to the electrode.

Another object of this invention is to provide an inlet positioned through the rigid casing to serve as an inlet for the gaseous medium, and further as an electrical conductor to effect one of the electric connections for discharging the heating unit, said inlet being insulated from the casing and having means establishing a gas-tight seal therebetween.

Another object is to provide in the inlet described in the above stated object, a valve for controlling the inlet port which is manually operable.

A further object of this invention is to provide on the inlet end of the cartridge a protective cap or casing which has extending from the outer surface thereof, two binding posts, one of which is insulated from the main casing and is connected by yielding means to the inlet member, and the other binding post in direct communication with the casing.

Another object of this invention is to provide a blasting cartridge provided with a heating cartridge capable of being discharged electrically, which is composed of the following ingredients in the proportions specified: 45 grams of aluminum and 120 grams of potassium chlorate, and accelerating or catalyzing agents in suitable amount such as sulphur, antimony tri-sulphide, ferric oxide and man-

ganese dioxide, varying from 2% to 20% of the chlorate content of the cartridge; said cartridge being contained in a paraffined paper envelope and having an electric wire capable of being volatilized by current passing therethrough and extending from the opposite ends of the heating cartridge to establish electric contact, one of said extensions being in the form of a yielding spring to provide for variances in the length of the heating cartridge.

These and other objects are accomplished by means of the arrangement disclosed on the accompanying sheet of drawings, in which—

Figure 1 is an elevation of a cartridge constructed in accordance with this invention;

Figure 2 is an enlarged cross sectional view of one-half of a cartridge constructed in accordance with this invention, showing one end thereof; and

Figure 3 is a similar view showing the other end thereof, the complete cartridge being represented when Figure 3 is placed on the right hand end of Figure 2.

The various novel features of the invention will be apparent from the following description and drawings and will be particularly pointed out in the appended claims.

Referring to the drawings, it will be noted that this invention relates to a cartridge comprising a rigid casing 10 having a reduced end 11 at one end and an end wall 12 at the other end; the end wall 12 being provided with an opening 13 and a shoulder 14 being threaded as at 15; the reduced end 11 having external threads 16. The reduced end of the casing forms a nozzle for directing the gases, is open and has provided on its edge a plurality of knife-edge projections 17 in the form of rings placed eccentric to each other. Positioned against the outer edge and in contact with the knife-edge ring 17 is the rupturable end wall 18 held in contact therewith by the shear ring 19 and the cap member 20, which is provided with screw threads in engagement with the threads 16 on the reduced end 11 of the casing 10. The rigid container or cartridge is made of suitable metal and the sealing knife-edge projections 17 are suitably hardened after the operation of machining so that they are harder than the body of the container and very much harder than the disk wall 18 which is pressed against them in the operation of closing the cartridge, the end wall 18 being made of relatively soft metal. The shear ring 19 is a separate piece and is made of metal which can be hardened since it forms a die through which the center part of the disk is forced when the cartridge is discharged. It is supported by the shoulder 21 machined in the cap 20 as shown, and the opening through the ring is slightly smaller than the diameter of the opening 22 in the cap so as to facilitate the passage of the sheared center part of the disk through the opening 22. The cap 20 is provided with a chamber portion 23 and transverse openings 24 and a small end opening 25 in the end wall 26. The cap member 20 accomplishes two functions in connection with the discharging of the cartridge, in that it first acts to spread or divide the issuing gas current and also catches the disk section sheared from the end wall 18, and second, it counteracts the first violent rush of gas at the moment of discharge and uses this force to prevent the cartridge from backing up in the drill hole and compressing the tamping, which action produces an additional void about the container, and, therefore, is detrimental to the best action.

The wall 13 through the closed end is provided with a shoulder 27 which acts as a seat for the insulator 28, the insulator receiving the enlarged base portion of the inlet member 29 which also acts as an electrode to convey current through the opening 13 in the closed end of the casing. The inlet member is provided with a stem 30 and a threaded boss 31 on the inner end thereof. Extending through the stem 30 is a passage 32 which has an outlet 33 into the interior of the casing and is formed at the other end of the stem with a knife-edge opening 34. Before the stem 29 is inserted through the opening 13 in the end of the casing, the stem being inserted from the left, as shown in Figure 3, an insulation 35 is molded on the stem in the middle portion thereof. After the stem is in position, other insulation and packing material 36 is placed around the end thereof so as to make the opening between the stem and the casing gas-tight. This packing is compressed and held in place by the ring 37 and its bushing of insulation 38 placed inwardly thereof. A valve is provided on the outer end of the stem which comprises a casing 39 attached as by threads 40 to the outer end of the stem, which has an internal cavity 41 with a transverse opening 42′ leading to the interior thereof. This casing has an open end provided with a reduced threaded portion 42 for receiving the valve adjusting rod 43 provided with a squared end 44 for the reception of a suitable manipulating tool, such as a key. The inner end of the rod 43 is recessed as at 45 and filled with some suitable material, such as bakelite, 46 adapted to engage and effect a tight seal with the knife-edge opening 34 on the edge of the stem. Attention is called to the fact that the bakelite filler in the pocket 45 is rotatable relative to the rod so that the bakelite filler does not turn relative to its seat and thereby effects a more perfect seal. The outer end of the valve casing is closed by means of a gas-tight seal comprising packing 47 and a gland 48. The valve housing is threaded as at 49 and has a skirt member 24 attached thereto for engaging the

ring 37 for compressing the packing 36 above referred to. The skirt 24 is also provided with a washer 50 abutting the outer edge thereof and adapted to form a seat for the coiled spring 51, the other end of which engages the metallic plate on the inner facing of the cap 54, to be later described.

Threaded to the reduced portion of the closed end 12 of the casing 10 is a collar 52 having external threads 53 on which is mounted a cylindrical cap member 54. The cap member is made of suitable metal and is provided with an internal lining 55 of insulating material. An end wall 56 forms a closure for the outer end of the cap 54 which is provided with screw threaded opening 57 and the central opening 58. Positioned in the screw threaded opening 57 is a binding post of the usual structure but having a swivel connection 59 and a bolt 60 in which the conducting wire is secured. Positioned through the central opening 58 is a second binding post comprising a bolt 61 having a head 62 on its inner end which overlies and retains the metallic plate 63 against the inner face of the closing wall 56. Between the metallic plate 63 and the end wall 56 is the insulating strip 64, and between the bolt 61 and the end wall 56 is an insulating bushing 65 whereby the electric connection from the second binding post is insulated from the casing of the cartridge.

Positioned longitudinally on the axis of the casing 10 is a heating cartridge and means for holding the cartridge in position, which means comprises a fitting 66 adapted to be threaded on the boss 31 of the inlet member and to be mechanically held thereon and to effect an electrical connection therewith. This fitting is externally threaded and has mounted on its outer surface a perforated tube 67 which is locked against rotation by the set screw 68. The fitting is also provided with a small internal duct 69 adapted to receive an electrical connecting wire 69′ which is engaged and held in position by the inner end of the locking screw 68. On the other end of the tube 67 is threaded a closing means which comprises two metallic fittings 70, 71 screwed together as at 72 and forming together the chamber 73. This closing element is attached to the end of the tube 67 by screw threads 74 and the metallic washer member 75 but is insulated therefrom by the insulation 76, 77 and 78. The inner end of the fitting is provided with a cup 79 which is adapted to receive one end of the electrical contact of the heating cartridge 80. The heating cartridge 80 is positioned within the tube 67 and has an electrical conducting wire positioned therethrough and extending from both ends thereof, one end fitting within the duct 69 held by the set screw 68 as above described, and the other end forming a spring coiled wire seated in the cup 79. Within the chamber 73 is a coiled spring 81 adapted to abut at one end the inner end of the casing 73, and at the other end the head 82 of the rod 83, the opposite end of which is in engagement as at 84 with the rupturable end wall 18.

In operation, the heating cartridge 80 is preferably composed of a mixture enclosed in a wrapper of any suitable type, such as a paraffined paper tube or sock, the mixture consisting of the following ingredients in the proportions specified: 45 grams of aluminum and 120 grams of potassium chlorate, and accelerating or catalyzing agents in suitable amount such as sulphur, antimony tri-sulphide, ferric oxide and manganese dioxide, varying from 2% to 20% of the chlorate content of the cartridge, the cartridge being further provided with an electric wire which is capable of being volatilized when heated by a current passing therethrough, either directly or in a coil fashion, and projecting from the opposite ends as above described. It is further desirable to place the heating cartridge centrally of the casing 10 so that there will be a more uniform dissemination of heat throughout the volume of liquid contents of the cartridge. In practice, it has been found that one form of cartridge which is desirable in operation, contains approximately 2¾ lbs. of carbon dioxide gas in a container of such a size that the gas will be compressed at approximately 500 volumes, and that the container is provided with a rupturable end wall which will give way at any pressure desired up to approximately 45,000 lbs. per square inch. As a heating unit, this invention contemplates a cartridge as above described, which will raise the temperature of the liquid to and above its critical temperature within a time interval of 1/20th of a second, or less, this being the necessary rate to develop pressure sufficient to break the rupturable end wall 18. If a slow heating is effected or a slow evaporization for any reason whatsoever, the excessive pressure will cause a slight buckling of the rupturable end wall 18 an extent sufficient to permit a slow escapement of gas to provide for the restoration of the normal pressure. In the type of heating cartridge described, the mixture generates an enormous amount of heat in the short time interval due to the fact that the volatile wire is positioned internally thereof and in contact with a substantial portion of the mixture. In addition to the heat generated and disseminated by the volatilization of the wire, a gaping spark follows passing through the cartridge being conducted by the metallic aluminum present in the mixture.

In practice, this invention contemplates using carbon dioxide gas for the reasons set forth in the Patent No. 1,632,887 of Crawford et al., above referred to, and further, that it is found to embody the most satisfac-

tory and desirable properties for this use.

The casings 10 are adapted to be refillable. In each instance, after the cartridge has been discharged, the casing is to be recovered and reloaded to be used over again. In charging the casings in this manner, it is first necessary to remove the cap 20, the shear nut 19 and the rupturable wall 18, and by a suitable tool, to unscrew the tubular cartridge containing means 67 by turning the fitting 66 from its screw threaded engagement with the threaded parts 31. When this is done, the tube is opened by unscrewing the bushing 75 at the threads 74 and forcing therein a new heating cartridge 80 in the manner shown, great care being taken to make sure that the projecting wire 69′ is held by the set screw 68 in the duct 69. When the tube 67 is reloaded, it is again placed within the casing and a new rupturable end wall is placed against its seat and the shear ring and cap members put back in assembled relation. Attention at this time is called to the yelding connection for the rod 83 for the purpose of establishing electrical contact between the heating cartridge and the casing, any variances in distance during the various installations being provided for by the yielding spring 81. The heating unit being in place, it is next necessary to charge the container with carbon dioxide gas which is done through the opening 42 in the valve housing 39. A suitable inlet is positioned against the opening 42 and the valve rod 43 is screwed outwardly from the seat 34 from the stem portion of the inlet member, it being understood at this time that the cap 45 and the electrical connecting spring are removed from the end of the cartridge. Sufficient carbon dioxide is introduced under pressure to assure at least 500 volumes of gas in the container at suitable temperature to insure the liquid state of all of the gas. In such condition, the valve rod is again seated and the outer protective casing 54 is screwed in place, the spring 51 being positioned against the washer 50 and the metallic plate 63 for effecting the proper electrical connection. When the parts are thus assembled, the cartridge is ready to be connected to a suitable source of current at the two binding posts and placed in a drill hole to be set off.

The electrical connection for setting off the heating unit and the cartridge will be first to the middle binding post, through the bolt 61, to the plate 63, through the spring 51, washer 50, skirt 24 and stem 32, through the fitting 66 to the cartridge wire which extends through the cartridge 80. Attention is called at this time to the fact that all the parts above enumerated are insulated from the casing 10 and parts in metallic connection therewith. The other end of the wire from the cartridge engages the fitting 71 and the contact is then completed by the coiled spring 81, the rod 83, to the rupturable end wall 18 and thence through the casing 10 back to the other binding post which is in direct electrical communication with the casing.

From the above description, it can be seen that there is provided in this invention a device which will accomplish all the objects stated in the objects of the invention specified in this application.

We claim:

1. A blasting cartridge comprising a rigid container having a rupturable wall at one end and a perforated rigid wall at its opposite end, an electrical conducting inlet member positioned through the perforation and insulated from said casing, a cap member enclosing said inlet member having two electrical terminals, one connected directly thereto and the other insulated therefrom, and a yielding conductor between said last mentioned terminal and said inlet member.

2. A blasting cartridge comprising a refillable rigid casing having a rupturable end wall, an electrical conductor extending through said casing and insulated therefrom, means in said casing for receiving an electrically explosive heating cartridge, said means being connected to said electrical conductor at one end and having a yielding conductor for connecting it to said casing at its other end.

3. A blasting cartridge comprising a refillable rigid casing having a rupturable end wall, an electrical conductor extending through said casing and insulated therefrom, means in said casing for receiving an electrically explosive heating cartridge, said means being mechanically held by and electrically connected to said conductor, and means comprising a yieldingly mounted rod for connecting said first named means and said casing.

4. A blasting cartridge adapted to discharge gas from one end thereof, comprising a rigid casing having a rupturable end wall, a cage cap member positioned on said discharge end and having transverse outlet openings whereby the expanding gas is discharged in a plane substantially at right angles to the axis of said cartridge.

5. A blasting cartridge adapted to discharge gas from one end thereof, comprising a rigid casing having a rupturable end wall, a cage cap member positioned on said discharge end and having a substantial surface in opposition to the outlet end of said casing whereby any tendency for said cartridge to move bodily during discharge is avoided.

6. A blasting cartridge comprising a rigid casing having a rupturable end wall, a shear ring positioned adjacent said rupturable wall, and a cap means for holding said shear ring and said rupturable wall in place, said cap means comprising a cage structure

for retaining said end wall when ruptured during discharge of said cartridge.

7. A blasting cartridge comprising a rigid casing adapted to contain a gaseous medium under pressure in an non-gaseous state, said casing having an electrical conductor passing therethrough but insulated therefrom, and an electrically explosive heating cartridge in said casing and containing means therefor comprising a perforated tubular member mechanically held by and electrically connected to said conductor at one end and being provided with a yielding rod contacting said casing and insulated from said tubular member at its other end, said conductor and casing being connected respectively to the two poles of a source of current.

8. A blasting cartridge comprising a rigid casing having a rupturable end wall of soft metal positioned against the end of said casing in contact with eccentric knife edge ring projections thereon, and a cap member for binding said parts together.

9. A blasting cartridge comprising a rigid casing having a rupturable end wall, liquefied carbon dioxide in said casing maintained under pressure, means within said casing for raising the temperature of said carbon dioxide to and above its critical temperature within a time interval of substantially one-twentieth of one second, and means for permitting an escape of gas from said casing without rupturing the end wall which is formed at a rate slower than one-twentieth of one second.

10. In a blasting cartridge of the type described, the combination of carbon dioxide under pressure and a heating unit therefor comprising substantially 45 parts of aluminum and 120 parts of potassium chlorate and a wire capable of being volatilized positioned therethrough.

11. In a blasting cartridge, the combination of a heating unit and carbon dioxide under pressure, said heating unit comprising substantially 45 parts of aluminum and 120 parts of potassium chlorate, and accelerating agents.

12. In a blasting cartridge, the combination of a heating unit and carbon dioxide under pressure, said heating unit comprising substantially 45 parts of aluminum, 120 parts of potassium chlorate, said mixture being enclosed in a wrapper, and having a volatile wire passing therethrough and extending for contact purposes from opposite ends thereof.

13. In a blasting cartridge, the combination of a heating unit and carbon dioxide under pressure, said heating unit comprising substantially 45 parts of aluminum, 120 parts of potassium chlorate, and accelerating agents, said mixture being enclosed in a wrapper and having a volatile wire passing therethrough and extending for contact purposes from opposite ends thereof.

14. In a cartridge, a rigid casing having a chamber portion and a cage portion and a rupturable wall separating said portions, a gaseous medium under pressure in said chamber, said cage portion having a transverse opening therein through which the gaseous medium escapes when said cartridge is discharged.

15. In a cartridge, a rigid casing having a chamber portion and a cage portion and a rupturable wall separating said portions, a gaseous medium under pressure in said chamber, said cage portion having a transverse opening therein through which the gaseous medium escapes when said cartridge is discharged, said cage portion having a wall of substantial surface opposed to said rupturable wall.

16. A blasting cartridge comprising a container, a heating element in said container extending longitudinally thereof, means in said container for cooperation with and for supporting said heating element from one end of said heating element, said heating element being substantially unsupported at its opposite end but having electrical contact with said container at such end.

17. A blasting cartridge, comprising a tube having two compartments of substantially the same diameter, a gaseous charge in one compartment and valve and electrical terminal means in said other compartment.

18. A blasting cartridge, comprising a tube having two compartments of substantially the same diameter, a gaseous charge in one compartment and valve and electrical terminal means in said other compartment, and removable means for enclosing said last named compartment while permitting access to said container parts.

19. In a blasting cartridge of the type described, a rigid reusable container adapted to receive a blasting charge and to be positioned within a drill hole and be discharged therein, and means for liberating the charge in a substantially transverse direction with respect to the drill hole when a substantially predetermined pressure is reached within said container.

20. In a blasting cartridge of the type described, a rigid reusable container adapted to receive a blasting charge and to be positioned within a drill hole and be discharged therein, and means for liberating the charge and directing the same in a substantially transverse direction with respect to the drill hole when a predetermined pressure is reached within said container.

21. In a blasting cartridge of the type described, a rigid reusable container adapted to receive a blasting charge and to be positioned in a drill hole and be discharged therein, means for releasing the charge in a substan-

tially axial direction upon the attainment of a predetermined pressure within said container and means for directing the released charge in a substantially transverse direction.

22. In a blasting cartridge of the type described, a rigid container adapted to receive a blasting charge, a venting device associated with said container and adapted to release the confined charge upon the attainment of a substantially predetermined pressure within said container, and a discharge cap for receiving and directing the released charge.

23. In a blasting cartridge of the type described, a rigid container adapted to receive a blasting charge, a venting device associated with said container and adapted to release the confined charge upon the attainment of a predetermined pressure within said container, and a discharge cap associated with said container and venting device for holding the same in operative relation and for receiving and directing the release charge.

24. In a blasting cartridge of the type described, a rigid container adapted to receive a blasting charge, said container having a discharge opening, a rupturable member for closing said opening and a discharge cap engaging said member and having adjustable connection with said container.

25. In a blasting cartridge of the type described, a rigid container adapted to receive a blasting charge, said container having a discharge opening, a rupturable member for closing said opening and a discharge cap engaging said member and having adjustable connection with said container, said discharge cap having a shear ring arranged in abutting relation to said member.

26. In a device of the character described, a rigid substantially cylindrical casing having a neck portion of reduced diameter at one end, a cap adapted to be adjustably secured to said neck portion and of an outside diameter substantially equal to that of the main portion of said casing, and pressure responsive means for venting the casing.

27. In a device of the character described, a rigid substantially cylindrical hollow casing having an open end, a discharge cap adapted to be applied to said end and having adjustable connection with said casing, an internal flange on said cap, a shear ring engaging said flange and a rupturable member interposed between said shear ring and the open end of said casing for normally sealing the same.

28. In a device of the character described, a rigid substantially cylindrical hollow casing having an open end, a discharge cap adapted to be applied to said end and having adjustable connection with said casing, an internal flange on said cap, a shear ring engaging said flange and a rupturable member interposed between said shear ring and the open end of said casing for normally sealing the same, said cap having a chamber beyond said flange and a plurality of radial discharge ports communicating with said chamber.

29. In a device of the character described, a rigid substantially cylindrical hollow casing having one end restricted to form a neck portion of reduced internal and external diameter, a cap adapted to be applied to said neck portion and having an outside diameter substantially equal to the maximum diameter of said casing, and a venting device clamped between said cap and the end of said casing.

30. In a device of the character described, a rigid substantially cylindrical hollow casing having one end restricted to form a neck portion of reduced internal and external diameter, a cap having threaded connection with the exterior of said neck portion, an internal flange on said cap, a shear ring abutting said flange, and a rupturable disc interposed between said shear ring and the end of said casing, said cap having transversely arranged discharge ports therein.

31. A discharge cap adapted to be applied over the discharge portion of a cartridge which is sealed by a rupturable member, said cap having an aperture through the end wall thereof for the reception of a tool to be used in dislodging obstructions within the cap.

32. In a blasting cartridge of the type described, a casing adapted to receive a blasting charge and ignition means for said charge comprising a circuit including two electrodes and a cap applicable to said casing and having means for placing said electrodes in circuit with a source of electricity.

33. A blasting cartridge substantially as defined in claim 32 and wherein the casing constitutes one of the said electrodes.

34. A blasting cartridge of the type described, a casing adapted to receive a blasting charge, an electrode passing through an aperture in said casing and insulated therefrom, an electrically activated heating device in circuit between said electrode and casing and a member applicable to said casing and having means for placing said electrode and casing in circuit with a source of electricity.

35. A blasting cartridge substantially as defined in claim 34 and wherein said member is in the form of a cap enclosing said electrode.

36. A blasting cartridge of the type described, a casing adapted to receive a blasting charge, an electrode passing through an aperture in said casing and insulated therefrom, an electrically activated heating device in circuit between said electrode and casing, a cap applicable to said casing and having means for placing said electrode and casing in circuit with a source of electricity, said cap comprising a cylindrical member having threaded engagement with said casing and

an end wall removably associated with said member and whereon said means are carried.

37. In a blasting cartridge of the type described, a casing adapted to receive a blasting charge, an electrode passing through an aperture in said casing and insulated therefrom and a heater cage carried by the inner end of said electrode and adapted to receive a heater unit inserted through an opposed aperture in said casing.

38. In a blasting cartridge of the type described, a substantially cylindrical casing adapted to receive a blasting charge, an electrode passing through an aperture in an end wall of said casing and insulated therefrom and a heater cage carried by the inner end of said electrode and adapted to receive a heater unit introduced through an aperture in the opposite end of said casing.

39. In a blasting cartridge of the type described, a casing adapted to receive a blasting charge, a member passing through an aperture in a wall of said casing, said member having a passageway therethrough terminating within the casing, a sleeve secured to said member exteriorly of the casing and a valve device adjustably associated with said sleeve and adapted to obstruct the end of said passageway, said sleeve having an aperture for the introduction of fluid pressure thereinto.

40. In a blasting cartridge of the type described, a casing adapted to receive a blasting charge and means for charging said casing comprising a member extending through an aperture in said casing, said member having a passage therethrough terminating within the casing and means for obstructing said passage at the outer end of said member, said means comprising a stem having a recess in an end thereof, an insert of relatively soft material disposed in said recess and adapted to engage the outer end of said member and means for moving said stem toward said member.

Signed at Harrisburg, Illinois, this 12th day of Feb. 1927.

DENT FERRELL.
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